ON *DIDYMORCHIS*, A RHABDOCOELE TURBELLARIAN INHABITING THE BRANCHIAL CAVITIES OF NEW ZEALAND CRAYFISHES.

By Professor William A. Haswell, M.A., D.Sc., F.R.S.

(Plates xx.-xxi.)

The Rhabdocoele Turbellarian with which this paper deals was found by me in the branchial chambers of *Paranephrops neozelanicus* from streams in the Province of Otago, New Zealand. It is, so far as I have had the opportunity of observing, practically an invariable companion of the Crayfish, having been found, though never occurring in large numbers, in all the specimens examined; and it appears to pass its entire existence in the interior of the branchial chambers of its host. My attention was first directed to it owing to some resemblances to the Temnocephaleæ, for allies of which I was then searching; and some of these resemblances are of sufficient importance to justify the conclusion that we have here probably the nearest known Rhabdocoele relative of the group in question.

The animal (Pl. xx., fig. 1) is about one millimetre in length and less than a third of a millimetre in greatest breadth. It is dorso-ventrally compressed, flat below, slightly convex above. The breadth is nearly uniform throughout when the animal is moderately extended, slightly greater towards the middle of the body. The anterior margin is nearly transverse, but moderately convex: the posterior is more strongly convex, and is thickened owing to the strong development of the muscular layers

There is no pigment anywhere except in the eyes. The latter are situated immediately in front of the pharynx, about a fourth of the total length behind the anterior margin, and are separated from one another by a space which is equal to about one-half of the breadth of the body in that region.

A remarkable feature is that cilia are developed only on a portion of the ventral surface, and are entirely absent round the margin and on the dorsal surface. Along the anterior and posterior margins open the ducts of numerous rhabdite-forming glands the viscid secretion of which, with the contained rhabdites, passes out from them, sometimes in considerable quantity.

Locomotion is effected sometimes by the action of the cilia of the ventral surface producing a slow gliding movement; at other times the animal "loops" along actively, the adhesive anterior and posterior regions being alternately fixed to and liberated from the surface of the substratum after the fashion of suckers.

The mouth has the appearance of a small transverse slit situated on the ventral surface nearly on a level with the eyes. The common genital aperture is a much smaller slit situated in the middle of the ventral surface about a fourth of the total length from the posterior margin.

Alimentary System.

The pharnyx (*ph.*) is of the type termed by Von Graff "pharynx doliiformis." Its length is about a sixth of that of the entire body; its breadth somewhat less. In the substance of its wall between the radial fibres are numerous large unicellular glands, the ducts of which are arranged regularly and open into the internal cavity close to the anterior margin of the pharynx. The intestine (*int.*) has a thick wall composed of large vacuolated cells full of granules which are collected into spherical masses, some of which are of relatively large size.

Nervous System.

The nervous system does not present any very noteworthy features. The brain is a transverse band of fibrous material situated on the dorsal side immediately in front of the anterior margin of the pharynx, and of groups of nerve-cells connected with this in front and at the sides. From the brain a single pair of longitudinal nerve cords passes backwards close to the lateral margins of the body.

The eyes are of very simple structure and resemble those of Rhabdocoeles in general.* Each consists of a cup of pigment, the granules of which are few, large and of regularly rounded form, and an enclosed structureless body not divided into cells.

Excretory System.

The excretory system opens on the exterior on each side on the ventral surface near the lateral margin almost opposite the posterior extremity of the pharynx. The opening (*exc.*) leads into a very narrow canal which enters a rounded mass of granular material. In this the canal winds about. Eventually two main canals are given off, one (*a.v.*) passing forwards, the other (*p.v.*) backwards. The former soon bifurcates. Of its two branches the inner soon also divides into an outer and an inner branch. The outer branch of the main canal runs forwards to the region in front of the eyes, where it divides into two branches, of which one is continued forwards towards the anterior margin, where it runs inwards and perhaps anastomoses with the corresponding vessel of the opposite side, while the other runs almost directly inwards and unites with the outer branch of the inner division of the main anterior canal to form a short single transverse vessel which passes into the corresponding vessel of the opposite side. The posterior main canal soon divides into two vessels which run backwards almost parallel with one another to a point just behind the posterior extremity of the testis where they unite to form a single transverse commissural trunk.

Reproductive System.

There are two compact testes (*t.*) of a somewhat oval shape, situated close to the posterior border of the body in immediate or almost immediate contact with one another posteriorly, lying with their long axes directed outwards and forwards. Their shape is a narrow oval, slightly curved, with the antero-internal

* R. Hesse, "Untersuchungen über die Organe der Lichtempfindung bei niederen Thieren." Zeitschr. wiss. Zool. 62 Bd. (1897).

border concave and the postero-external, which is divided into half a dozen lobes by shallow depressions, convex. Each testis has its vas deferens (Pl. xxi., fig. 1, *v.d.*), which leaves its inner border behind the middle of its length. The right vas deferens (*r.v.d.*) runs across the middle line to join the left. The common duct thus formed, a wide thin-walled tube, winds in a close spiral from the free extremity to the base of the penis, where it opens into a wide vesicula seminalis, from which the ejaculatory duct passes through the penis to open into a median chamber, the genital cloaca. Into the vesicula seminalis open also two sets of ducts (*gr.d.*) of the granule glands, the granules from which collect in masses in the interior of the base of the penis. The penis (Pl. xx., *p.*, and Pl. xxi., figs. 1 and 3) is a chitinous body situated a little to the left of the middle line, with its long axis directed obliquely, the proximal end anterior and external, the distal posterior and internal. It consists of a tubular or rather funnel-like basal portion, and a distal portion composed of a number of spines. The basal portion is very wide at the proximal end, the greatest width being nearly equal to the length. The spines are ten or twelve in number, some straight and dagger-shaped, others curved and tapering.

The female organs consist of a single ovary (Pl. xx. and Pl. xxi., figs. 1 and 2, *ov.*), oviduct and uterus (ootype), vitelline glands, vitelline ducts, and a receptaculum vitelli. The ovary is a pear-shaped body situated to the right of the middle line. The oviduct is given off from the narrower left end of the ovary; it is almost immediately joined by the wide short duct of the receptaculum vitelli. The common duct thus formed varies greatly in width in different specimens. In some it presents a sharp bend or twist, and in the lumen of this part of its course a mass of living sperms (fig. 2, *sp.*) was observed in several individuals. Further back it dilates to form a chamber which is apparently the ootype (*oot.*), and this opens by a wide vagina into the genital cloaca. The receptaculum vitelli (*r.v.*) is a rounded chamber situated somewhat to the right of the middle line. Into it,

where the short wide duct runs backwards from it, open the two vitelline ducts. The vitelline glands are a pair of narrow, irregularly lobed bodies which extend on either side between the intestine and the lateral border. There is no bursa copulatrix.

The eggs were found attached separately to the epipodites of the Crayfish. Each is enclosed in a chitinoid shell, having a slender pencil-like process projecting from it. Before it is hatched the young animal has completely assumed the characteristics of the adult, except that the reproductive organs are not yet developed.

The Rhabdocoele above described apparently approaches on the whole nearer to the *Vorticida* than to any of the other known groups. The form of the pharynx is essentially the same, and the general arrangement of the reproductive apparatus corresponds fairly closely. Perhaps also there may be some resemblance with regard to the excretory system, since in the genus *Vortex* the vessels seem to open on the exterior in the neighbourhood of the pharynx.

In the reproductive system the chief difference, in addition to the posterior position of the testes and the peculiar form of the penis, seems to consist in the absence of a bursa copulatrix. The integument of the *Vorticida* also appears to differ from that of the new form, the epidermis in that family assuming the form of a cylindrical epithelium; while in *Didymorchis* it is a thin protoplasmic layer with nuclei at wide intervals: and in the *Vorticida* the unicellular glands secreting rod-like bodies appear to be absent.

Von Graff's definition of the *Vorticida* is:—"Rhabdocoeler mit einer Geschlechtsöffnung, mit Keimdotterstöcken oder getrennten Keim- und Dotterstöcken, mit weiblichen Hülfsapparaten, stets einfachem Uterus und compacten paarigen Hoden: Mundöffnung bauchständig und in der Regel nahe dem Vorderende, Pharynx (mit 1 Ausnahme) ein Pharynx doliiformis. Das chitinöse Copulationsorgan sehr mannigfaltig."*

* "Monographie der Turbellarien i. Rhabdocoelider," p. 205.

One section of the *Vorticida*, including *Anoplodium*† and *Graffilla*,‡ are parasitic; but the new form is not in any way related to these, which have the brain and the pharynx greatly reduced.

The following appear to be the leading characteristic features of the new form, for which I propose the name *Didymorchis paranephropis*:—Pharynx a "pharynx doliiformis." Excretory system opening on the ventral surface by two apertures situated not far from the mouth and pharynx. A single reproductive aperture. A single compact ovary and two elongated vitelline glands. No bursa copulatrix. A pair of compact testes situated posteriorly in close contact with one another. A complex chitinous penis consisting of a tubular basal part and a distal system of spines.

EXPLANATION OF PLATES XX.-XXI.

Plate xx.

General view of the external features and internal organisation of *Didymorchis* from the dorsal aspect, (× 250).

a.v., anterior main vessel of excretory system. *exc.*, opening of excretory system. *g.o.*, genital opening. *int.*, intestine. *oot.*, ootype (uterus). *ov.*, ovary. *p.*, penis. *ph.*, pharynx. *p.v.*, posterior main vessel of excretory system. *r.v.*, vitelline receptacle. *t.t.*, testes. *vit.*, vitelline glands.

Plate xxi.

Fig. 1.—Ventral view of the reproductive apparatus. *gr.d.*, granule ducts. *r.v.d.*, right vas deferens. *te.*, *te.*, testes. Other letters as in Plate xx.

Fig. 2.—Outline of female reproductive organs of another specimen, dorsal aspect, ♀ opening of vagina. *sp.*, mass of sperms in oviduct. Other letters as in Plate xx.

Fig. 3.—Dorsal view of chitinous parts of penis.

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† A. Schneider, "Ueber einige Parasiten der Holothuria tubulosa i. Anoplodium parasita." Müller's Archiv, 1858. Von Graff, tom. cit. p. 376.

‡ H. von Ihering, "Graffilla muricicola, eine parasitische Rhabdocoele." Zeitschr. f. wiss. Zoologie, Bd. xxxiv. 1880.